TeleVision, Inc.
2308 Chadbourne Dr.
Plano, TX 75023
972-333-0712

January 8, 2017

Marlene H. Dortch, Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, DC 20554

Re: RM-11778, *Fixed Wireless Communications Coalition, Inc., Request for Modified Coordination Procedures in Bands Shared Between the Fixed Service and the Fixed Satellite Service*

Dear Ms. Dortch:

I am writing in support of the petition filed by the Fixed Wireless Communications Coalition to improve parity in frequency coordination in the bands shared between the Fixed Service and the Fixed Satellite Service.

I am currently the President of the National Spectrum Management Association (NSMA), Chairman of the Telecommunications Industry Association (TIA) TR-45 Working Group for Microwave Systems (which is rewriting TIA Bulletin 10F) and former Chairman of the TIA Fixed Point-to-Point Microwave Section. I am Editor of the Wiley-IEEE Press RF and Microwave book series and have published two books on fixed point-to-point microwave communication (*Microwave Communication* and *Digital Microwave Communication*) and contributed a chapter to the book *Microwave Technology*. I am also a fixed point-to-point microwave radio consultant. My consulting clients have included all the major carriers and my industry activities have brought me in touch will all the major coordination companies and microwave radio manufacturers.

In my more than 40 years in this industry I have been personally responsible for implementation of fixed point-to-point microwave systems on four continents and many systems throughout the United States. I have a continuing interest in deploying microwave radio systems in support of current and emerging requirements. This unique technology continues to provide cost effective, timely support for current and emerging requirements in ways no other technology can.

The Issue

The question at hand is how to coordinate and license radio systems in frequency bands shared by both the Fixed (point-to-point microwave radio) Service (FS) and the Fixed Satellite Service (FSS). Currently the Commission's rules (Part 25) permit every FSS earth station to routinely coordinate and license an entire frequency band, both polarizations and the entire geostationary arc regardless of how little spectrum the earth station plans to use and how few

satellites it plans to access. This practice is sometimes called "full-band, full-arc" coordination. No other radio service is permitted to license spectrum regardless of need. The Commission's rules for FS (primarily Part 101) are quite different. Part 101 rules only permit licensing of the spectrum (specific frequency, bandwidth, polarization and azimuth) that will be utilized at least 50% within 30 months of construction. Future requirements must be deferred and managed as "growth channels". As I shall show by Lower 6 GHz example later, this FS licensing policy has allowed many FS radio paths to share the same band. The policy of the FSS of allowing a single earth station to license all frequencies, bandwidths, polarizations and azimuths blocks the frequency coordination of fixed point-to-point microwave radio systems in the same general area as the earth station. This will be illustrated later by an example of 4 GHz.

What is the Purpose of These Comments?

The fixed point-to-point microwave radio service has attempted to change the FCC's "full-band, full-arc" satellite earth station licensing policy twice in the past. In 1994 the TIA Fixes Point-to-Point Microwave Section and the National Spectrum Management Association teamed to provide much of the text of the newly-created Part 101. As part of the proceedings (ET Docket No. 92-9, RM-7981), they attempted to change the rules regarding "full-band, full-arc" but were unable to achieve consensus with the satellite community. In 2000 the fixed microwave community again petitioned the Commission to change the rules (IB Docket No. 00-203, RM-9649). The Commission declined and gave three main reasons: 1. the fixed community's proposal did not accommodate all needs of the satellite operators, 2. the fixed community had not demonstrated they were harmed by the policy, and 3. the fixed community had offered no method for changing the rules.

The current proposal addresses concern 1. All earth station operational frequency requirements are to be accommodated. All the satellite operators are required to do is make their needs public. I will address concerns 2 and 3 below.

How Did We Get Here?

As the Fixed Wireless Communications Coalition's Petition for Rulemaking pointed out, in 1967 the Commission's policy for licensing earth stations was rather broad: "This [full-band, full-arc] procedure is consistent with the practice followed within the United States which has had little or no adverse effect upon terrestrial systems in the areas concerned." The reason this statement was true at the time was not a characteristic of the technologies involved (as evidenced by the Bell Labs article cited below) but a desire of the satellite operators to make it true. Many of the satellite operators also had extensive microwave radio networks. These microwave networks extended over most of the United States and heavily utilized 4 GHz. Satellite operators had to place their earth stations at locations that isolated them from the extensive incumbent microwave systems. Placement of earth stations at remote locations and the use of earth berms, terrain depressions and metal fences to provide RF shielding were common practice.

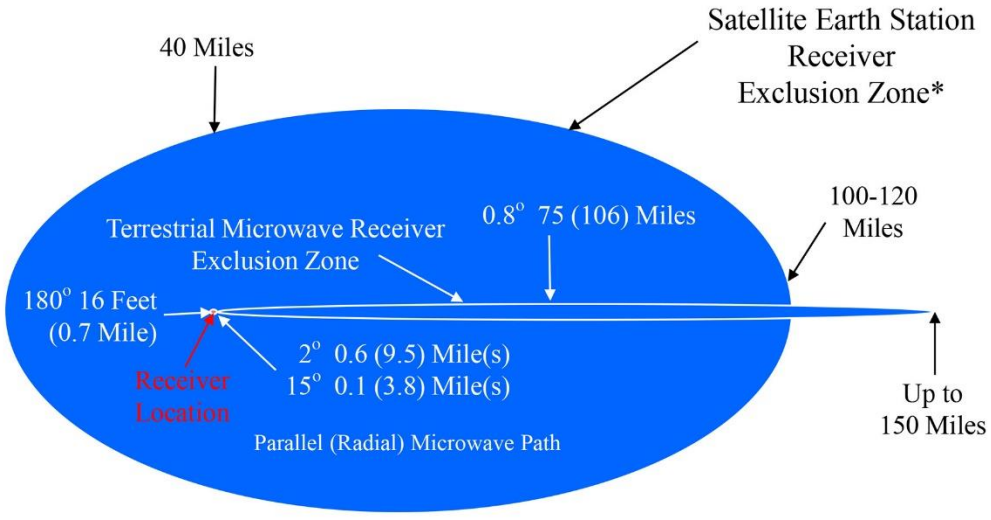
Today the situation is quite different. The nationwide microwave networks are gone. Satellite operators have proliferated. Satellite earth stations are routinely deployed in urban areas and often on top of buildings. While this has obvious benefit to the satellite operators, it does not

represent typical engineering standards used in the late 1960's. Today full-band, full-arc coordination definitely adversely affects potential terrestrial systems.

What is the Impact to FS?

Both FSS and FS stations employ sensitive receivers. The satellite earth stations typically use an unshielded parabolic antenna that has relatively poor off main axis angular discrimination of rf signals. FS stations usually use shrouded antennas with high off-axis discrimination. When placed in a highly visible, unobstructed location, the sensitivity of a satellite earth station to co-channel FS radio signals extends over a much larger geographical area than does that of a FS station.

As Harold Curtis of Bell Labs noted, "… the separation between [FS and FSS] systems must be of the order of 100 to 120 miles or more when the antenna of the common carrier [FS microwave] transmitter or receiver is pointed directly at the satellite ground station. If the antenna is beamed 90 degrees or more from the satellite site, the minimum distance may be of the order of … 40 miles … [for a FS parabolic dish antenna]." For reference, at mid-latitudes, 40 miles represents about ± 0.6 degrees of latitude and ± 0.75 degrees of longitude; 110 miles represents about ± 1.5 degrees of latitude and ± 2 degrees of longitude.



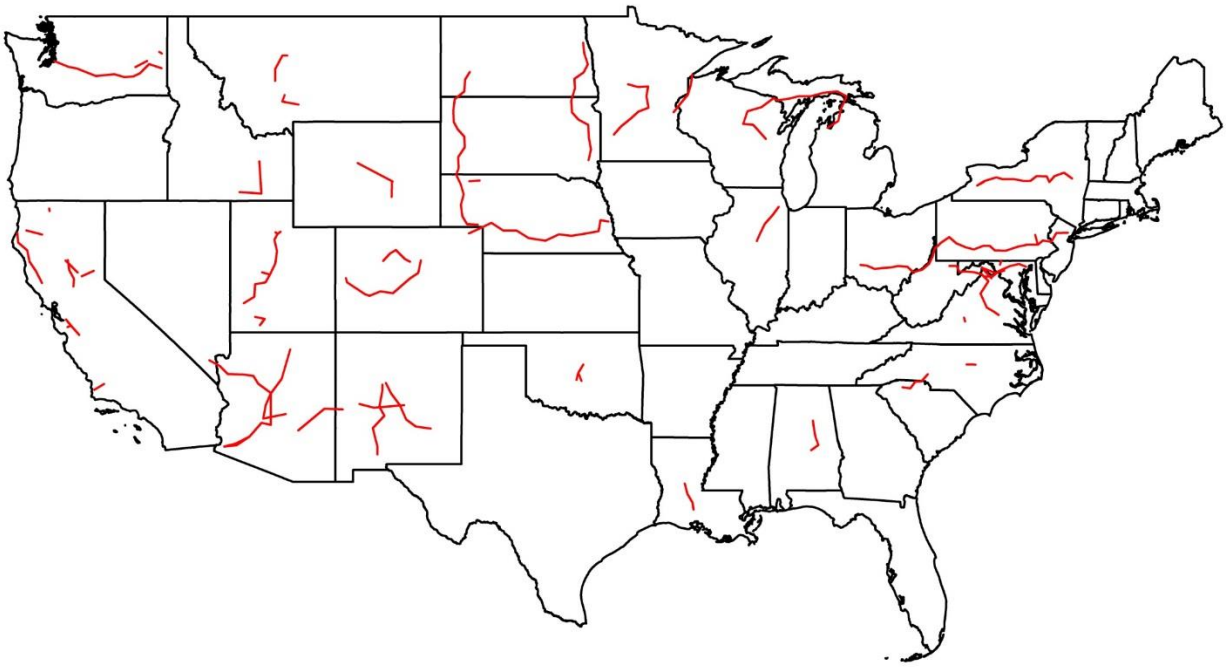
Satellite Service Uses All Frequencies at All Azimuths Within a Band

Terrestrial Microwave Uses a Pair of Frequencies Within a Narrow Angular Wedge

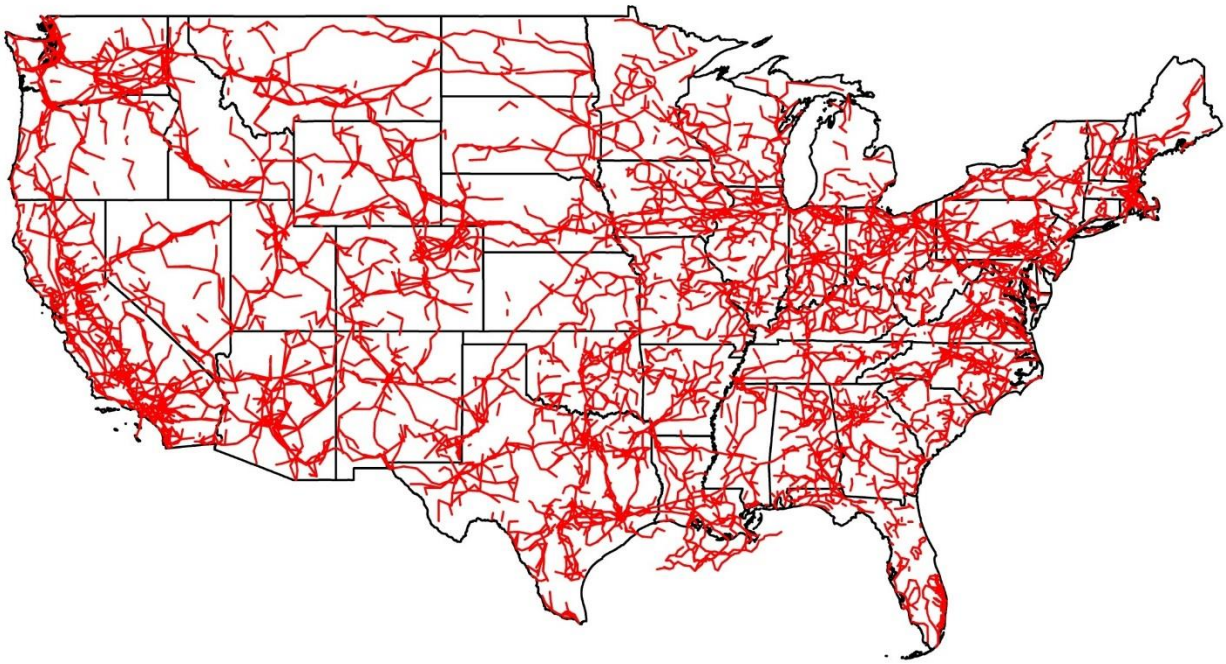
* Curtis, H. E., " Interference between Satellite Communication Systems and Common Carrier Surface Systems," *Bell System Technical Journal*, May 1962, pages 921-943.

FSS and FS Receiver Exclusion Zones

The difference in FS utilization of the 4 and Lower 6 GHz bands is dramatic.

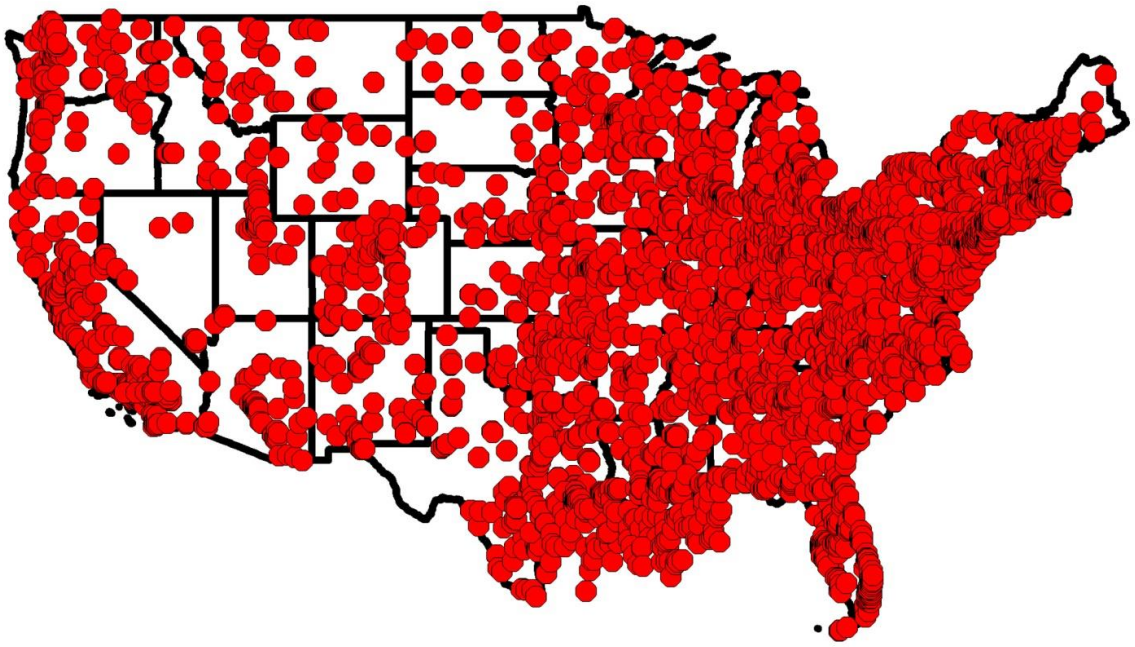


Current 4 GHz Fixed Point to Point Networks
(based upon FCC ULS files from May 2015)



Current Lower 6 GHz Fixed Point to Point Networks
(based upon FCC ULS files from May 2015)

Today satellite earth stations cover most of the United States and virtually all of the areas of greatest need for more spectrum.



Current Fixed Satellite Service 4 GHz Earth Station Locations

Currently the 4 GHz band has 71 different duplex FS microwave paths (including Hawaii and Alaska). Most of these paths are legacy multiline systems. At the same time, Lower 6 GHz has 20,126 duplex FS microwave paths (including Hawaii and Alaska). The dramatic difference in the number of FS paths in 4 GHz and Lower 6 GHz is not a function of technology. The 4 GHz band was a popular FS band in the '60's and '70's. From working with several clients who have attempted to use 4 GHz for FS paths, I can state with conviction that the primarily limitation to FS deployment in 4 GHz is the "utilization" of all frequencies, polarizations and azimuths by widely deployed satellite earth stations.

What is the Impact to Emerging Technologies?

While the issue of lack of detailed knowledge of actual FSS earth station frequency utilization is of significant interest to the Fixed Wireless community, it impacts other potential users as well. The Citizens Broadband Radio Service (CBRS, Part 96) will be operating slightly lower in frequency than 4 GHz. Frequency coordination will be managed by Spectrum Access Systems (SASs). The SASs will need detailed information regarding the incumbent FSS earth stations. The data currently required [§96.17 (d) (1)] is not adequate to perform a detailed frequency coordination (for example, it lacks frequency, channel bandwidth, polarization and modulation type). Lacking that information, the SAS will have to make worst case assumptions and some new systems will be denied unnecessarily.

The Commission and the United States Senate are looking at potential new shared services in existing frequency bands. The Mobile Now act proposed in the Senate would allow commercial wireless services to share 4 GHz (S.19). Presumably a SAS would be used to manage frequency coordination. This approach will experience the same coordination limitations as CBRS if detailed FSS earth station operational information is not available.

What Can We Do?

Efficient spectrum management only occurs when all relevant technical details are available. The question remains as to how this could be accomplished in frequency bands shared by FS and FSS. The United States is not the only country with this dilemma. Industry Canada has dealt with this issue by adopting detailed requirements (CPC-2-6-01, Issue 5 April 2015, Spectrum Management and Telecommunications, Client Procedures Circular Procedure for the Submission of Applications to License Fixed Earth Stations and to Approve the Use of Foreign Satellites in Canada). These requirements may be found at http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf01385.html. They are outlined in the Appendix. Similar rules adopted by the United States would solve these frequency coordination issues.

Conclusion

Satellite operators have operational needs which should be protected. Likewise fixed point-to-point operators need the opportunity to utilize the bands to which they are legally entitled. Today the fixed community is disadvantaged and this situation should be corrected. The current proposal addresses that need.

It is recommended that United States satellite applications provide specific system information similar to that supplied by Canadian applications. There would be no impact to existing or planned FSS operations if satellite earth station operators include in their license requirements provision for emergencies and satellite failures. This approach could work as evidenced by Canada's success.

This suggestion is merely a way of disclosing to interested parties what the satellite operators plan to do. It would also eliminate the frequency warehousing – unique to the satellite service - currently caused by the FCC licensing policy. In light of the current need for increased utilization of radio spectrum, this change in policy is clearly in the public interest. I request the FCC to issue a Notice of Proposed Rulemaking based on the FWCC's petition.

Respectfully submitted,

George Kizer

George Kizer
President, TeleVision, Inc.

Appendix: Outline of the Canadian Method of Satellite and Earth Station Licensing

Per Industry Canada CPC-2-6-01, a complete application consists of the following:

Fixed Earth Station Technical Certification

38. Provide a copy of the agreement between the applicant and the space station operator as an attachment.
40. Indicate the height (in metres) of the antenna centre above ground level.
41. Indicate the diameter of the antenna (in metres) accurate to two (2) decimal places, for example,
42. Indicate the isotropic gain of the transmit antenna (in dBi) in the direction of maximum radiation.
43. Indicate the transmit antenna half-power beamwidth, in degrees.
44. Indicate the isotropic gain of the receive antenna (in dBi) in the direction of maximum radiation.
45. Indicate the receive antenna half-power beamwidth, in degrees.
46. Indicate the ITU antenna reference pattern.
47. If the pattern is not in the ITU antenna reference pattern list indicated in the question above, attach the antenna measured radiation diagram (taking as a reference the direction of maximum radiation) for each band of operation.
48. Indicate the operating azimuthal angle or lower limit of the range (in degrees), clockwise from True North, in the direction of the satellite.
49. Indicate the operating azimuthal angle or upper limit of the range (in degrees) if applicable, clockwise from True North, in the direction of the satellite.
50. If the earth station is communicating with a GSO, indicate the operating elevation angle (in degrees) of the antenna from the horizontal plane in the direction of the satellite.
51. If the earth station is communicating with an NGSO system, provide the range of minimum operating elevation angles (in degrees) of the antenna from the horizontal plane, at various azimuths, between the lower and upper operating azimuthal angles, in the direction of the satellite. The applicant must enter the values in an array. The values are paired with those of the following question.
52. If the earth station is communicating with an NGSO system, provide the azimuths corresponding to the minimum antenna elevation angles (in degrees). The applicant must enter the values in an array. The values are paired with those of the preceding question.

Transmitting Earth Stations (multiple per station)

56. Provide the frequency band of operation.
57. Indicate the transmit carrier frequency (in MHz) of the emission(s).
58. Indicate the transmit occupied bandwidth.
59. Enter the bandwidth of the assigned transmit frequency band if different from the necessary bandwidth. The assigned frequency band may be wider than the necessary bandwidth to accommodate for Doppler shift.
60. For each carrier, indicate the transmit necessary bandwidth using the International Telecommunication Union (ITU) designators.

61. For each carrier, indicate the necessary transmit class of emission using the ITU designators.
62. Indicate the type of polarization of the transmitted wave in the direction of maximum radiation.
63. In the case of linear polarization, indicate the angle of polarization of the transmitted wave in the direction of maximum radiation.
64. Indicate the maximum peak envelope power (dBW) supplied to the input of the antenna.
65. Indicate the maximum power density in dB (W/Hz) supplied to the input of the antenna averaged over the worst 4 kHz band for carriers below 15 GHz, or averaged over the worst 1 MHz band for carriers above 15 GHz.
66. Indicate the minimum peak envelope power (dBW) supplied to the input of the antenna.
67. If the minimum peak envelope power was not provided, state the reason.
68. Indicate the minimum power density in dB (W/Hz) supplied to the input of the antenna averaged over the worst 4 kHz band for carriers below 15 GHz, or averaged over the worst 1 MHz band for carriers above 15 GHz.
69. If the minimum power density in dB (W/Hz) was not provided, state the reason.
70. State whether the transmit modulation type is digital or analog.
71. Where the transmit carrier is digitally modulated, indicate the type of modulation.
72. Where the transmit carrier is digitally modulated, indicate the number of modulation phases.
73. Where the transmit carrier is digitally modulated, indicate the modulated bit rate in Mb/s (data rate plus any bits added as a result of overhead, i.e., the addition of coding and error correction bits).
74. Provide the number of telephone channels.
75. For all other types of transmitter modulation, including analog, provide the particulars including the number of voice channels.

Receiving Earth Stations (multiple per station)

76. Indicate the receive beam designation corresponding to the beam of the associated satellite as per questions 35 to 39.
77. Indicate the receive class of station*.
78. Indicate the receive nature of service**.
79. Indicate the receive carrier frequency or frequencies (in MHz) of the emission(s).
80. Provide the frequency band.
81. Indicate the receive occupied bandwidth.
82. Enter the bandwidth of the assigned receive frequency band if different from the necessary bandwidth. Assigned frequency bandwidth may be wider than the necessary bandwidth to accommodate for Doppler shift.
83. For each carrier, indicate the necessary bandwidth using the ITU designators.
84. For each carrier, indicate the class of emission using the ITU designators.
85. Indicate the type of polarization of the received wave in the direction of maximum gain.
86. In the case of linear polarization, indicate the angle of polarization of the received wave in the direction of maximum gain.
87. Indicate, in degrees Kelvin, the lowest total receiving system noise temperature with reference to the output of the receiving antenna of the earth station under “clear sky conditions.” This value shall be indicated for the nominal value of the angle of elevation

when the associated transmitting station is aboard a geostationary satellite and, in other cases, for the minimum value of angle of elevation.

88. State the carrier-to-noise ratio (C/N) in dB.
89. If the carrier-to-noise ratio (C/N) was not provided, state the reason.
90. State whether the receive modulation type is analog or digital.
91. Where the receive carrier is digitally modulated, indicate the type of modulation phases.
92. Where the receive carrier is digitally modulated, indicate the number of modulation phases.
93. Where the carrier is digitally modulated, indicate the modulated bit rate in Mb/s (data rate plus any bits added as a result of overhead, for example, of coding and error correction).
94. For all other types of transmitter modulation, including analog, provide the particulars including the number of voice channels.
95. Provide the number of phone channels.
98. The applicant should attach the earth station coordination area diagrams.

3.2 **Satellite**

3.2.1 Give the name of the satellite and the satellite operator. Include the name(s) of the satellite(s) as notified to the ITU, as well as the commercial name(s) of the satellite(s).

3.2.3 Name the administration responsible for the satellite and indicate whether the administration is a member of the WTO.

3.2.4 Give the dates that the administration coordinated and notified the satellite network, in its current or proposed operating condition, to the International Telecommunication Union (ITU), and provide the ITU special section reference number and publication date for both filings. If the satellite network has not yet been notified or if the notice is not yet published, provide a list of administrations with which coordination is required and information describing the status of coordination for each of these administrations.

3.2.5 For geostationary orbit satellites, provide the orbital position of the satellite in degrees West longitude.

3.2.6 For non-geostationary orbit satellites, provide the number of orbital planes, the number of satellites in each orbital plane, the angle of inclination of each orbit, and the altitudes (in kilometers) of the apogee and perigee of the satellites.

3.2.7 Describe the extent and nature of the satellite coverage. Include coverage maps if necessary.

3.2.8 List the frequency bands that will be used by the satellite, and indicate which bands the associated earth station(s) will use.

3.2.9 Describe the types of services to be provided.

Associated Space Station Information

35. Identify the space station(s) with which communications will be established.
36. Indicate whether the satellite, with which the earth station will be communicating, is a geostationary satellite (GSO) or a non-geostationary satellite (NGSO).
37. If the satellite is a GSO, indicate its orbital position.
38. Provide a copy of the agreement between the applicant and the space station operator as an attachment.

*** Class of Station Designators**

AL	Aeronautical radionavigation land station
AM	Aeronautical radionavigation mobile station
AT	Amateur station
BC	Broadcasting station, sound
BT	Broadcasting station, television
E1	Space research (active sensor) space station
E2	Space research (passive sensor) space station
E3	Space station in the Earth exploration-satellite service (active)
E4	Space station in the Earth exploration-satellite (passive)
EA	Space station in the amateur-satellite service
EB	Space station in the broadcasting-satellite service (sound broadcasting)
EC	Space station in the fixed-satellite service
ED	Space telecommand space station
EE	Space station in the standard frequency-satellite service
EF	Space station in the radiodetermination-satellite service
EG	Space station in the maritime mobile-satellite service
EH	Space research space station
EI	Space station in the mobile-satellite service
EJ	Space station in the aeronautical mobile-satellite service
EK	Space tracking space station
EM	Space station in the meteorological-satellite service
EN	Space station in the radionavigation-satellite service
EO	Space station in the aeronautical radionavigation-satellite service
EQ	Space station in the maritime radionavigation-satellite service
ER	Space telemetering space station
ES	Station in the inter-satellite service
ET	Space station in the space operation service
EU	Space station in the land mobile-satellite service
EV	Space station in the broadcasting-satellite service (television)
EW	Space station in the earth exploration-satellite service
EY	Space station in the time signal-satellite service
FA	Aeronautical station
FB	Base station
FC	Coast station
FD	Aeronautical station in the aeronautical mobile (R) service
FG	Aeronautical station in the aeronautical mobile (OR) service
FL	Land station
FP	Port station
FX	Fixed station
LR	Radiolocation land station
MA	Aircraft station
ML	Land mobile station
MO	Mobile station
MR	Radiolocation mobile station

MS Ship station
NL Maritime radionavigation land station
NR Radionavigation mobile station
OD Oceanographic data station
OE Oceanographic data interrogating station
PL Combination of two or more classes of station (limited to collective entries made under the terms of the ITU's Radio Regulations, Article 20.5)
RA Radio astronomy station
RM Maritime radionavigation mobile station
RN Radionavigation land station
SA Meteorological aids mobile station
SM Meteorological aids base station
SS Standard frequency and time signal station
TA Earth station in the amateur-satellite service
TB Aeronautical earth station
TC Earth station in the fixed-satellite service
TD Space telecommand earth station
TE Satellite EPIRB in the mobile-satellite service
TF Fixed earth station in the radiodetermination-satellite service
TG Ship earth station
TH Earth station in the space research service
TI Coast earth station
TJ Aircraft earth station
TK Space tracking earth station
TL Mobile earth station in the radiodetermination-satellite service
TM Earth station in the meteorological-satellite service
TN Fixed earth station in the radionavigation-satellite service
TO Mobile earth station in the aeronautical radionavigation-satellite service
TQ Mobile earth station in the maritime radionavigation-satellite service
TR Space telemetering earth station
TT Earth station in the space operation service
TU Land mobile earth station
TW Earth station in the earth exploration-satellite service
TX Fixed earth station in the maritime radionavigation-satellite service
TY Base earth station
TZ Fixed earth station in the aeronautical radionavigation-satellite service
UA Mobile earth station
UB Earth station in the broadcasting-satellite service (sound broadcasting)
UD Space telecommand mobile earth station
UE Earth station in the standard frequency-satellite service
UH Mobile earth station in the space research service
UK Space tracking mobile earth station
UM Mobile earth station in the meteorological-satellite service
UN Mobile earth station in the radionavigation-satellite service
UR Space telemetering mobile earth station
UT Mobile earth station in the space operation service

UV Earth station in the broadcasting-satellite service (television)
UW Mobile earth station in the earth-exploration-satellite service
UY Earth station in the time signal-satellite service
VA Land earth station

**** Nature of Service Designators**

AS2 Stations using adaptive system (A radiocommunication system which varies its radio characteristics according to channel quality. [ref. the ITU's Radio Regulations No. 1.109A])
AX Fixed station used for provision of services related to aircraft flight safety
CO Station open to official correspondence exclusively
CP Station open to public correspondence (Any telecommunication which the offices and stations must, by reason of their being at the disposal of the public, accept for transmission. [ref. the ITU's Radio Regulations No. 1.116])
CR Station open to limited correspondence
CV Station open exclusively to correspondence of a private agency
FS Land station established solely for the safety of life
HP Fixed station using high altitude platform (A station located on an object at an altitude of 20-50 km and at a specified, nominal, fixed point relative to the Earth. [ref. the ITU's Radio Regulations No. 1.66A])
MX Fixed station used for transmission of meteorological information
OT Station open exclusively to operational traffic of the service concerned
PX Fixed station used for press transmission
RC Non-directional radiobeacon
RD Directional radiobeacon
RG Radio direction-finding station
RT Revolving radiobeacon
ST Fixed station using tropospheric scatter (The propagation of radio waves by scattering as a result of irregularities or discontinuities in the physical properties of the troposphere. [ref. the ITU's Radio Regulations No. 1.164])